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S. AD. NO.

COORDINATION ANNEX

TCCD 59-1

"Aircraft Maintenance in a Theater Army"

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COORDINATION - COMBAT DEVELOPMENT AGENCIES

TCCD 59-1

"Aircraft Maintenance in a Theater Army"

1. This study was forwarded to 18 Combat Development Agencies for comment. Sixteen replies were received.

2. Agencies that stated general concurrence are:

US Army Engineer School
US Army Command and General Staff College
US Army Medical Service
US Army Artillery and Missile School

3. Agencies that offered no comments are:

US Army Special Warfare School
Military Police Board
US Army Combat Development Experimentation Center
USCONARC Special Weapons Developments

4. Pertinent comments from Combat Development Agencies with USATCDG discussion are listed below:

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a. THE ORDNANCE BOARD COMMENTS:

(1) "The subject study has been reviewed and found to contain a most convincing and interesting treatment of the theory of using cannibalization as the only source of supply for large numbers of low usage line items.

(2) "The Ordnance Corps has many of the same type maintenance problems as those discussed in the study for aircraft. Therefore, the results of the proposed test of the procedures developed, would be of particular interest to members of the Ordnance Board. Please keep us informed, if at all possible, of the result of all tests conducted as a result of this study."

USATCDG DISCUSSION: None.

b. US ARMY AVIATION SCHOOL COMMENTS:

(1) "Subject study appears to offer a sound approach to the problem of aircraft maintenance in a theater army. The concept of reducing spare parts inventory by 95% and maintenance personnel by 63% is in consonance with the overall maintenance objectives of the United States Army Aviation School.

(2) "The system proposed in the study depends heavily on experience factors obtained during the maintenance of individual types of aircraft. Obtaining such factors will be a continuing process if the system is to be applied to any new types of aircraft.

(3) "The United States Army Aviation School concurs in need to test the Case Institute method of aircraft maintenance along the lines proposed in the test agenda."

USATCDG DISCUSSION: None.

c. THE QUARTERMASTER BOARD COMMENTS:

(1) "The Quartermaster Board has reviewed the subject study and concurs in the concept and recommended test agenda.

(2) "The study has analyzed a very complex subject in a practical manner. The proposed plan for parts support appears to assure a reduction in inventory and at the same time improve the availability of frequently used items. The extent to which cannibalization will satisfy the requirements for infrequently used parts has been proven only on a theoretical basis. This theory, and the suggested means of reducing manpower to create the optimum balance between idle men and idle aircraft appears to offer great possibilities. However, it is believed, as proposed in the study, that the chances of error are such that adoption of the concept should be made only after a realistic field test has confirmed the findings of the study."

USATCDG DISCUSSION: None.

d. US ARMY ARMOR SCHOOL COMMENTS:

(1) "The US Army Armor School has reviewed this excellent study and, with one exception, concurs. This exception is the proposed elimination of the third echelon maintenance capability from the division and the armored cavalry regiment. An organic third echelon maintenance capability is essential to these two type units for the following reasons:

(a) "Organizational planning for the future indicates that:

1. "The density of aerial vehicles will increase significantly in tactical units.

2. "Aerial vehicles will be integrated into combat and combat support units at echelons below division.

(b) "It is the opinion of the Armor School that as more aerial vehicles appear in lower tactical echelons, these vehicles must be considered, insofar as maintenance is concerned, as just another vehicle. The maintenance system for aerial vehicles should eventually parallel the system that has proven effective for ground vehicles. The maintenance system for aerial vehicles should be so designed that maintenance personnel of the various echelons work and live at the organizational level where their use is habitually required.

(c) "In order to insure the maximum availability of aerial vehicles, the tactical commander must have the capability of influencing third echelon maintenance efforts directly without depending completely on support obtained from higher echelons.

(d) "If the divisions and armored cavalry regiments have no organic third echelon maintenance capability, they must depend on either the rapid exchange of unserviceable for serviceable aerial vehicles, or maintenance units coming forward to make necessary repairs. Enemy action may preclude this movement, particularly as increased dispersion causes greater distances between tactical and support units.

(2) "Attention is invited to an Armor School study, 'Aerial Vehicle Requirements for Armor Units.' A copy of this study was furnished to the US Army Transportation Combat Development Group, 21 December 1960. This study describes the Armor School's position on aerial vehicles within armor units in the 1965-1970 period."

USATCDG DISCUSSION:

The subject study was performed within the current time frame (1959-1963) and all calculations were based on an aircraft density of approximately 1645 aircraft in the field army with a division aviation company of 56 aircraft for the ROTAD organization. However, by application of the procedures developed in this study, Transportation Corps personnel can rapidly determine a solution for any specific set of conditions. The concept of removing organic field maintenance from the division aviation company and consolidating this maintenance becomes even more valid as additional aircraft units, each with fewer numbers of end items, are added. The maintenance plan developed in this study takes advantage of the fact that 50 to 100 miles ground distance to an aircraft field maintenance location is roughly equal timewise, to a distance of 10-25 miles for ground vehicles. The savings in manpower, parts fragmentation, and the added capabilities of consolidated maintenance facilities is so drastic that any attempt to assign organic field maintenance to each small operating unit is totally unrealistic. Mobile contact teams are provided by the maintenance plan to perform on-site maintenance or to replace non-flyable aircraft in exchange for a serviceable item and to receive the non-serviceable item wherever it is located. Action required to remove the unserviceable item then becomes the field maintenance organization responsibility.

e. CHIEF CHEMICAL OFFICER COMMENTS:

"Subject study has been reviewed and found to be acceptable with minor exceptions as listed below:

- (1) "Limited tests of cannibalization (page 7, Incl 3).

The concept of cannibalization as contained in AR 750-50 indicates that

the aircraft should not be completely dismantled. Only mandatory recoverable items should be removed and placed into the supply system. The rest of the aircraft should be left "as is" and protected from the elements only to the extent of preventing further damage or deterioration. Parts should be removed only as required. The wholesale disassembly of all wrecked aircraft, and storage of the items, would be a major operation and would probably be prohibitive in terms of personnel and warehouse space.

(2) "All requirements for 'fringe' items must be reflected in the supply system. While the cannibalization point may be operated by a maintenance unit, all recovered parts must go through the supply channel to insure that the demand data is reflected.

(3) "The cannibalization point should be located as far to the rear of the combat zone as possible, with regard given to the time required to get parts forward. It should be under the operational control of the Central Supply and Stock Control Agency for the theater who directs the removal of recoverable items and the furnishing of fringe items as required.

(4) "This study presents a problem area that has been recognized for a long time by the Army for items of equipment other than aircraft. The Selective Stockage System and Project MASS were designed especially to solve this problem for combat vehicles and artillery. It has since been extended to cover all technical services. Controlled cannibalization is a part of this system.

(5) "It is requested that this office be advised of the results of the test program."

USATCDG DISCUSSION:

Concur with comments (1) and (3). With few exceptions, "fringe" items should not be reflected in data that may generate a supply action. The purpose of the cannibalization test is to determine which low usage or "fringe" items can be supplied from this source and thus eliminate supply actions.

f. US ARMY AIR DEFENSE SCHOOL COMMENTS:

(1) "The United States Army Air Defense School agrees that the concept of maintenance of Army aircraft by controlled cannibalization is one that deserves the closest investigation. However, the study 'Aircraft Maintenance in a Theater Army,' does not provide acceptable answers to a number of problem areas. To assist in the test phase proposed in paragraph 3 of the basic letter, the following questions are posed:

(a) "How is cannibalization to be controlled?

(b) "How are attrited aircraft to be recovered, and by whom?

(c) "What means will be provided for feed-back of information on usage of parts from attrited or least economically repairable aircraft? What prevents the removal of an identical item from several aircraft at different shops?

(d) "Was any comparison made between time and cost of supplying low usage items from the manufacturing facility or removing them from attrited aircraft?

(e) "How does the deadline time for aircraft compare, using present repair parts stockage procedures versus cannibalization?

(f) "How much of the present aircraft deadline time is due to supply activity? Will this time decrease under the proposed system?

(g) "The data presented on Fort Rucker repair parts usage does not provide all necessary information.

1. "Of the 8,000 line items not used, how many were supplied by usage of next higher assembly?

2. "Were any aircraft repaired by utilization of the apparently unused line items at a higher echelon?

3. "What type of stock control was used? Did it insure complete parts utilization recording?

4. "How many line items were not utilized because of faulty supply procedures?

5. "How many line items were requisitioned for use but not supplied because of non-availability?

(2) "One specific comment is made. Paragraph 1.1 indicates that this concept can be applied to equipment other than aircraft. While this may be correct, such a general statement cannot be made without further investigation. This statement should be deleted.

(3) "Despite the failure of the study to satisfactorily answer questions posed above, the plan to test aircraft maintenance by controlled cannibalization deserves serious consideration. It is recommended that a very closely controlled small scale evaluation of this maintenance system be implemented.

USATCDG DISCUSSION:

Much of the discussion relative to this comment is contained in the comments and discussion of the Chief Chemical Officer (para 4e). Studies performed by and for the Ordnance Corps and the Corps of Engineers indicate that this study concept and the method can be applied to equipment other than aircraft.

g. US ARMY INFANTRY SCHOOL COMMENTS:

(1) "The US Army Infantry School has reviewed subject study and suggests that full advantage has not been taken of the Army's experience in vehicle and equipment repair parts matters which may also be applicable to aircraft maintenance.

(2) "Recommend subject study include:

(a) "Analysis of previous repair parts experience concerning vehicles and equipment.

(b) "The feasibility of standardizing certain high mortality parts used in Army aircraft. Example: The H-13 and L-19 aircraft both use basically the same starter.

(c) "Consideration of contact maintenance teams which may prove to be more efficient in some instances than requisitioning individual parts or transporting disabled aircraft."

USATCDG DISCUSSION:

(1) Do not concur in the recommendation that the study include an analysis of parts experience concerning vehicle maintenance. Consideration was given to studies pertaining to Army vehicles (jeep, 2½, 6x6, tank) by the study group during the development of the study.

Work accomplished by Operations Research Office, the Corps of Engineers and the Ordnance Corps was carefully considered. Prior to and during the conduct of this study, an extensive search was instituted for all studies and work done in the maintenance area. Every subject having an impact on the total maintenance system was researched and a large number of field trips were made to keep pace with the work in progress. The United States Air Force, Navy Department, Department of the Army, the Technical Services (especially Ordnance and Engineers), work in foreign countries, civilian industry, research organizations, universities, etc., were included in the research so that no work would be overlooked, and that which was already done would not be duplicated. As a result, this study is believed to have taken advantage not only of Army experience but of maintenance systems experience per se.

(2) The standardization of components for maximum interchangeability between end items was considered, but not included, in this study since the Transportation Materiel Command has an active program in this area.

(3) Contact teams are a part of the Case Maintenance Plan, page 121.

h. US ARMY WAR COLLEGE COMMENTS:

(1) "It may be well to consider personalized repair parts service but any idea of personal contact and individual attention to each item and each requisition, coupled with air express for any class, item or commodity group of the supply system, must be examined with a great degree of reservation. Such service requires people and with the slightest

relinquishing of controls can snowball into a burdensome force of "expediter." Effectiveness of any such special attention system markedly decreases as the number of items and/or individual actions increases. It should be remembered that aircraft parts will not be the only commodity or class of supply vying for the always inadequate amounts of air shipment space and communications media available.

(2) "Controlled cannibalization can be a valuable adjunct to any maintenance or supply system when kept in proper perspective. There are grave doubts whether it should be relied upon to be the keystone of a system or as a system unto itself.

(a) "Actual experience will be that the same part from a damaged-cannibalized aircraft will be needed for a number of out-of-service repairable aircraft as a result of weather, terrain and/or tactical conditions causing the same part to then be cannibalized or else parts secured from an independent outside source. Once the initial, relatively small number of more frequently needed parts are removed from the cannibalized craft, the maintenance unit is left with a hard-to-handle 'carcass' or 'hangar queen' on its hands for an indefinite period of time. Multiply this by the number of 'hangar queens' that a unit must have on hand to care for its maintenance load and the task of maintaining its repair parts on hand in an assembled configuration will become apparent.

(b) "To enable having a knowledge of the parts taken from or still available on one or more cannibalized aircraft being utilized as a parts source, it will be necessary for the maintenance unit to keep some form of "stock" or "parts" control and inventory records. Thus the

savings that may be expected in this area are questionable, especially so since records of parts mortality (supplied via cannibalization and otherwise) must be maintained for procurement and parts quality improvement purposes. Unless well conceived in advance and carefully implemented to achieve standardization between units, cannibalization repair parts demand and supply records will very quickly become a hopelessly snarled monster that may well defeat the whole aircraft program.

(c) "Utilization of parts from cannibalization can be advantageous and an economy where a stock of selected parts, positioned in echelon according to expected demand, properly inventoried and recorded is maintained on hand. In this case parts cannibalized from irreparable equipment, are added to the parts inventory at appropriate level and are then reflected in a cut-back of parts subsequently ordered at each level from the rear. Delays inherent in locating and disassembly of a needed part from a 'carcass' are also eliminated in this more refined cannibalization procedure.

(3) "Additionally, and most important, utilizing one or more aircraft on hand as a source of parts is simply another way of providing a stockage of all and every part that an aircraft may contain or require. It cannot be credited as enabling a drastic reduction in parts stockage since in fact one or more of every part will be being maintained on hand.

(4) "It is well to assume that it will not be permitted to "raid" the pool habitually, to operate aircraft above specified and agreed operational levels - however, so long as flyable aircraft are on hand and pilots available to fly them, there will be a strong tendency to so "raid"

the pool. This practice has to be combated with essentially every type of equipment susceptible to or employing replacement pool stockage.

(5) "One of the cardinal dangers from cannibalization can be the failure to insert proper and adequate feed-back data into the parts procurement and supply system, to insure parts usage factors correctly reflect heightened demands, for procurement purposes. For other types of equipment, parts shortages sufficiently serious to immobilize equipment have been known to develop as a result of 'parts switching' concealing a need to change basis of procurement. In this system adequate safeguards must be incorporated to insure a like situation does not accrue to aircraft operations.

(6) "The problem of many thousands of very low usage parts, bought and not used, will not be solved by cannibalization or by field expedients. Rather it must be solved at its source procurement. This can only be done by better, more accurate estimates of parts life and cutting back on procurement quantities before they are on hand in unusable amounts. Uncontrolled cannibalization can work adversely in this regard by falsifying usage factors used by procurement agencies.

(7) "As for cannibalization negating a need to make accurate estimates of requirements for low-usage parts, this is a fallacious expectation. While the need for certain of the low-usage parts would be filled by cannibalization (compensated by complete aircraft replacement) at the same time many of the other low-usage parts remaining on the "carcass" would go unused, a likewise uneconomical wastage of parts. Maintenance of so vital an element of the Army's equipment field as aircraft cannot be

dependent upon the hit-or-miss expectation that parts will become available by cannibalization, without adequate determination of the need for repair parts and this covered by procurement. A barrage of recriminations would derive from the first instance of a need developing with parts not available and none under procurement.

(8) "In considering net savings via cannibalization reducing the average age of the fleet, an adverse factor must not be overlooked. Whenever an aircraft or other piece of military equipment is cannibalized, any of its parts that are reused carry only their remaining service life to the gaining item of equipment. Thus a gear box with only one-fourth of its service life remaining, if used on a relatively new aircraft, imparts its service life thereto and makes that aircraft no more dependable than its oldest, weakest or most worn out component. It is difficult to visualize operational aircraft, always dependent upon uninterrupted, continuous performance of each critical component, employing recovered, used, and, to varying extents, worn repair parts. It would seem that an element of real danger always exists in employing parts from combat or crash-damaged aircraft unless the most exhaustive and extensive of technical inspections and tests are first made to insure the absence of unrelieved stresses and strains, or other insidious defects. Such tests and inspections involve costs that operate adversely on other savings.

(9) "The theory of ranking all down aircraft in order of increasing repair costs, with the most costly repair done only if this is less costly than replacement will work well in a completely static situation where time is available. In an operational situation with

constant pressure to keep a maximum of aircraft in use, time for perspective analysis will not be available. A better solution is establishment of limits in terms of repair time required for individual planes to the end that the maximum number are made and/or kept operational.

(10) "Nowhere in this study does there seem to be a treatment of the manner in which the matter of property accountability for cannibalized repair parts, etc., will be handled, or of the cost attendant with such records and recording operations. This would seem to be an essential consideration during peacetime and almost as much so during supply scarcity periods when hostilities are in progress.

(11) "The statement that 'much of the detailed complexity of maintenance is shown to be irrelevant to optimization of the over-all operation, and hence need not be considered in making major decisions,' may be acceptable in theory or in the establishment and operation of a mathematical, paper model. However, in practice, complexity is one of the factors that precludes optimization of maintenance and must be considered in both major and minor decisions."

USATCDG DISCUSSION:

(1) Reference para (1), the study analysis shows that approximately 200 different line items account for 90 percent of parts costs. Properly controlled, this number of line items will remain relatively constant. If the study is even partially accurate, millions of dollars are involved in these few line items and personalized attention appears to be justified. One justification for this specialized attention is to reduce emergency actions which require priority over other supplies vying for air shipment and communications space.

(2) Reference para (2), the problems relating to cannabilization can only be answered by the tests proposed by the study. It is, however, entirely possible that a number of "carcasses" may be more easily handled and controlled than the thousands of individual line items that are replaced by these carcasses. The amount of records needed and the procedures of an extensive cannibalization program can again only be determined by test.

(3) Reference para (3), the procurement of a complete aircraft in lieu of spare parts is recommended because: (a) It does provide one of each part, and (b) a complete aircraft costs only a fraction of the cost of these same items purchased as individual spare parts line items.

(4) Reference para (4), the tendency to "raid" maintenance float equipment pools can only be controlled by command action.

(5) Reference paras (5), (6), and (7), the ultimate value of cannibalization can only be realized if this method can, in fact, replace procurement of many low-usage items. This information, (determined by the proposed tests), must then be utilized by procurement agencies and appropriate adjustments made in low-usage parts procurement. It is worthy of note that a test as recommended by the study can be accomplished while low usage parts are still available through normal channels. Procurement changes to eliminate these parts from future stockage would only result if the test so indicates.

(6) Reference para (8), gear boxes are time change components and fall in the high usage category. If none are available, then one-fourth of service life may be better than nothing. However, it is not

contemplated that a high usage item such as a gear box would come from cannibalization unless sufficient justification existed. Inspection of parts from crash-damaged aircraft will be required; but most low-usage parts are non-moving, hence non-wearing parts and most will require only visual inspection.

(7) Reference para (9), ranking in order of repair costs must consider "time to repair" as a major, if not the deciding factor.

(8) Reference para (10), the study was developed to support a wartime situation where property accountability would not be a deciding factor. If applicable to peacetime operations, accountability procedures would be required.

(9) Reference para (11), the study attempts to point out areas where vast savings may be possible. No change, as radical as that proposed by total acceptance of the study, could be accomplished without creating other complications. The findings and recommendations of the study offer possibilities worthy of test.